

A look at the June 14 2012 Straight-line Wind Event in Eastern Minnesota

Event Synopsis

On the afternoon of Thursday, June 14 2012, a few supercells developed just south of the Twin Cities metro area and slowly moved eastward. These storms tracked over the same area, and this is often referred to as “training thunderstorms”. This setup usually results in flooding, and in fact over 8 inches of rain fell in portions of Rice and Goodhue County, which caused rises along the Cannon River and its tributaries. However, one of these storms strengthened and was responsible for significant wind damage in southern Goodhue County. A large area of straight-lined winds knocked over trees, power lines, and even some buildings.

Before the severe weather occurred, the southeasterly winds feeding into the storm, called “inflow”, intensified in response to the strengthening updraft. The strong updraft was able to support large hail at around 15,000 to 20,000 feet above the ground. As this hail core descended to the ground, it caused the downdraft to strengthen. This downdraft reached the ground with incredible force, and spread out ahead of the storm. The radar images below illustrate how this storm developed, and why it was able to produce the damage that it did.

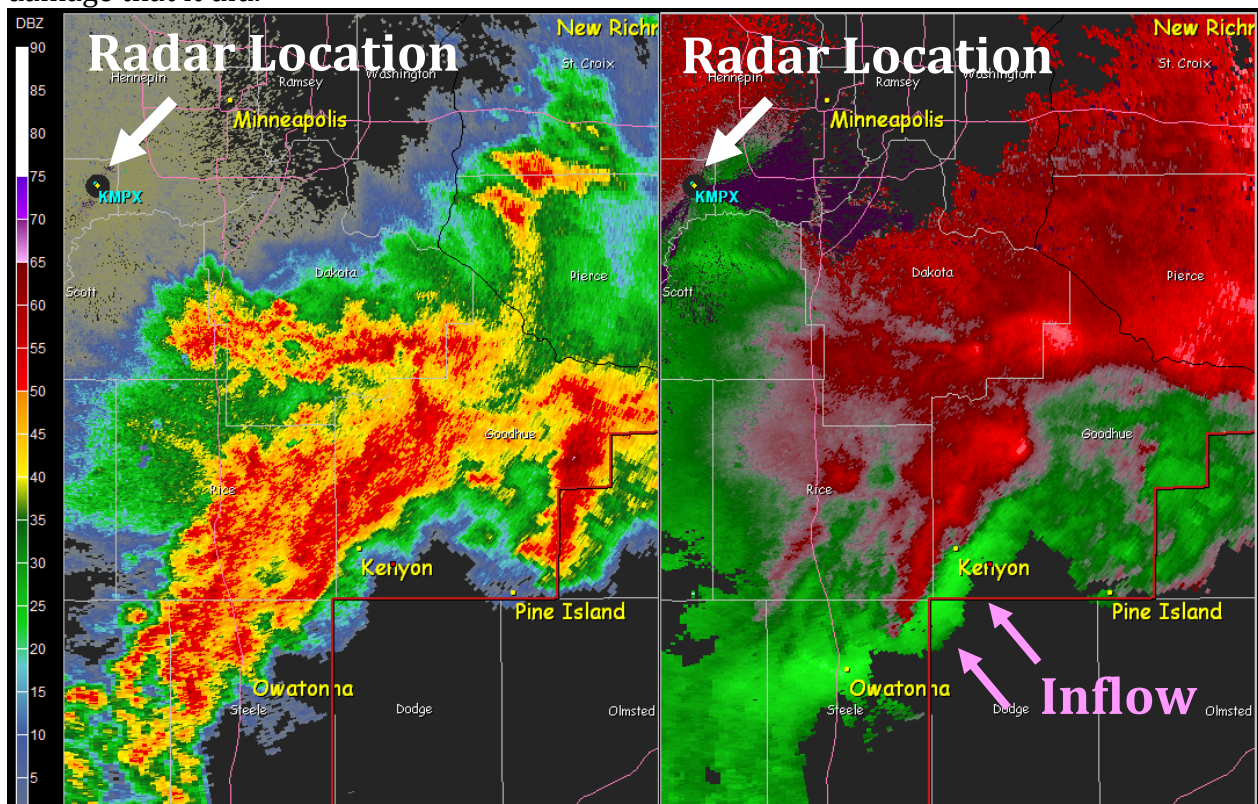


Figure 1: The image above is from June 14 at 645pm. It shows radar reflectivity on the left, which is just all the rain and hail inside the storm. The warmer colors (yellows, reds, pinks) mean that there is more large hail or heavy rain in that part of the storm. The right hand image shows velocity, which tells us how the particles are moving relative to the radar located in the upper left of the picture in the white circle. The green colors show where the particles are moving towards the radar, and the red colors show where the particles are moving away from the radar. When air is moving into the storm, we call that “inflow”.

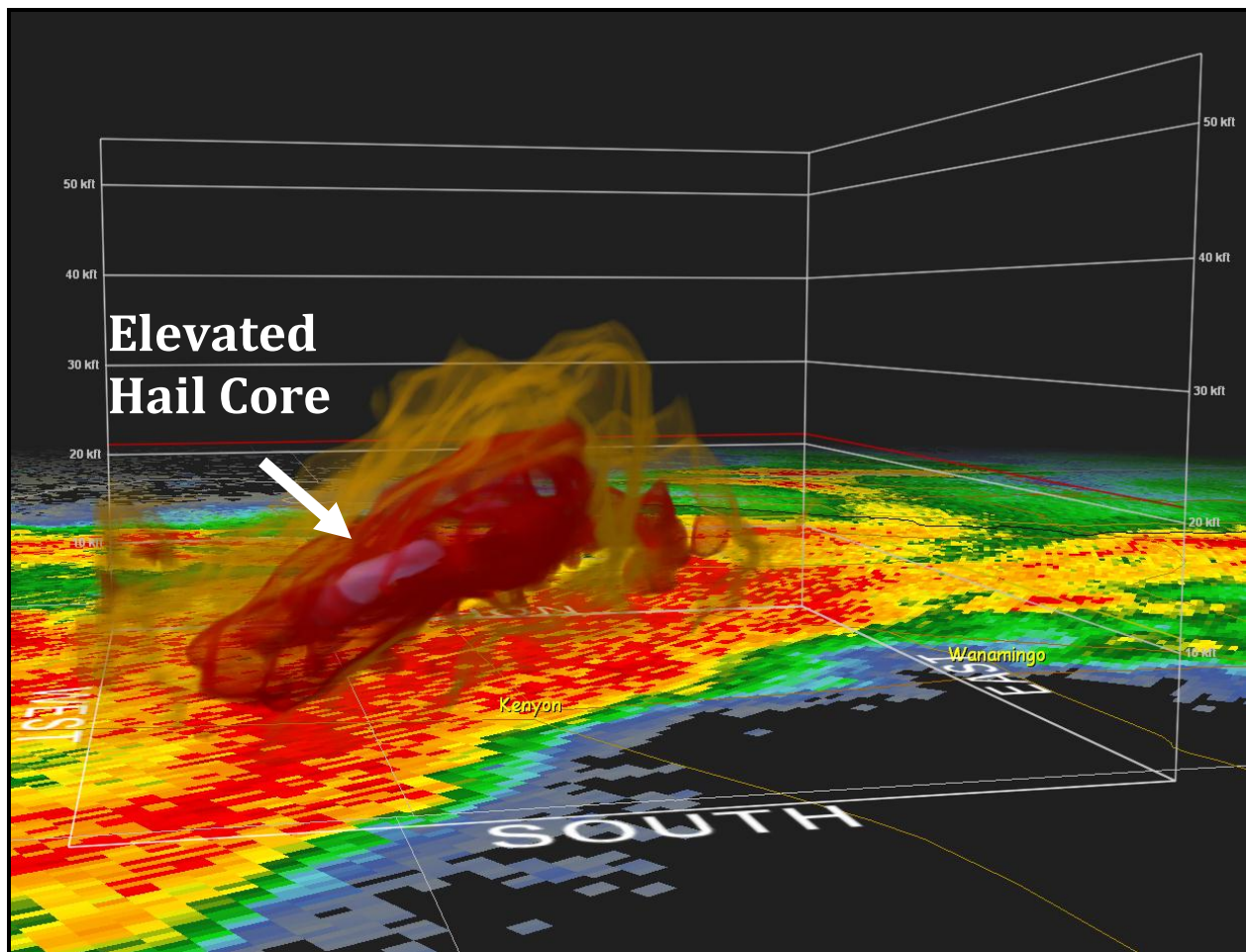


Figure 2: The image above is radar reflectivity from June 14 at 650pm. It gives us a 3D perspective of the developing storm as viewed from the south looking north. The pink shaded area shows the elevated hail core that is located about 15,000ft, or 3 miles above ground level. Notice how there are not any pink pixels in the lowest scan, which gives supporting evidence that the hail core is still aloft in the storm.

Over the next few minutes, the storm began to intensify further, and produced widespread damage from west of Kenyon through Pine Island and into Wabasha County. The following images show the storm at its peak.

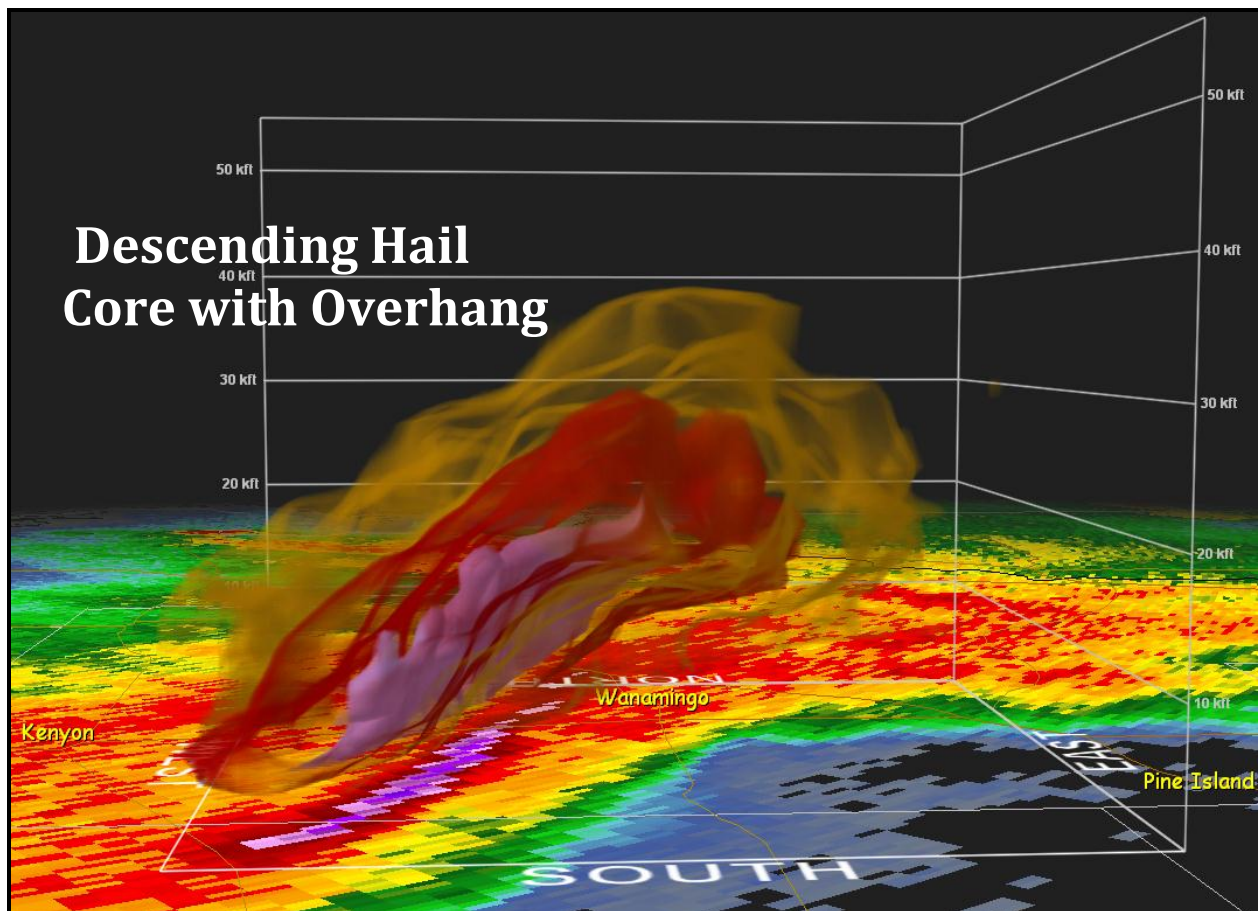


Figure 3: This 3D image is radar reflectivity from 709pm, as the storm was headed toward Wanamingo MN and about to cross Hwy 52. The reflectivity core had increased, and notice the pink line in the lowest scan which tells us that the hail core is reaching the ground. Another interesting feature of this image is the "forward overhang" in the reflectivity, which is another indicator of a very strong thunderstorm. Forward overhang refers to the high reflectivity at about 20,000ft that is several miles ahead of the high reflectivity at ground level.

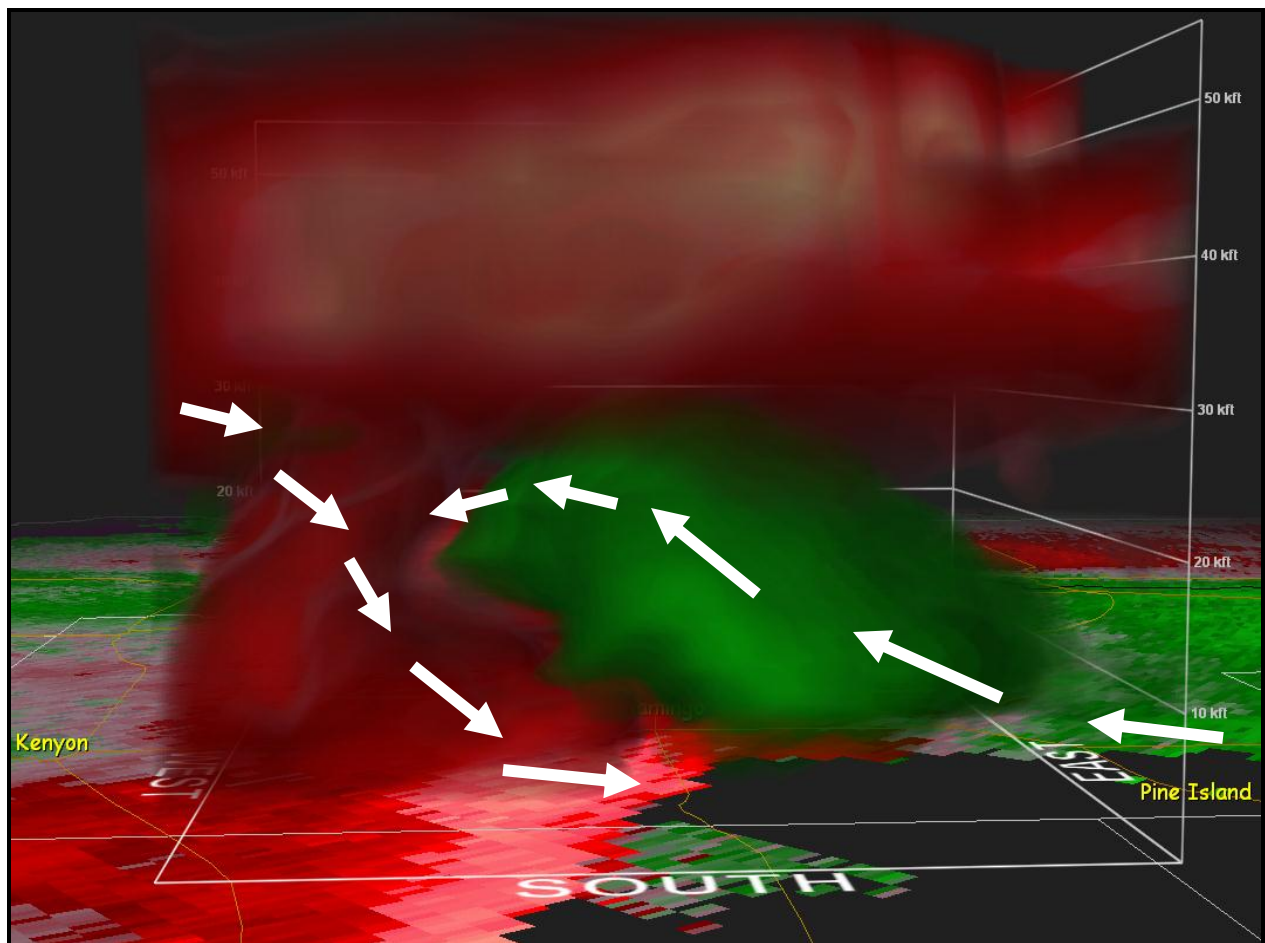


Figure 4: This 3D image is radar velocity from 709pm, as the storm was headed toward Wanamingo MN and about to cross Hwy 52. Recall from earlier that this shows how the particles are moving relative to the radar. In this case, the large green area shows the inflow into the storm, while the red area shows the downdraft region which is where the damaging winds are occurring. The white arrows help to illustrate the airflow within the storm.

These strong thunderstorms are capable of producing wind damage that rivals that of a weak tornado. In this case, the velocity signatures on radar did not show rotation, and the storm structure was a classic “straight-lined wind event”. Sometimes there can be brief spin-ups along the leading edge of the storm, but these are not tornadoes because there is no circulation in the storm itself.

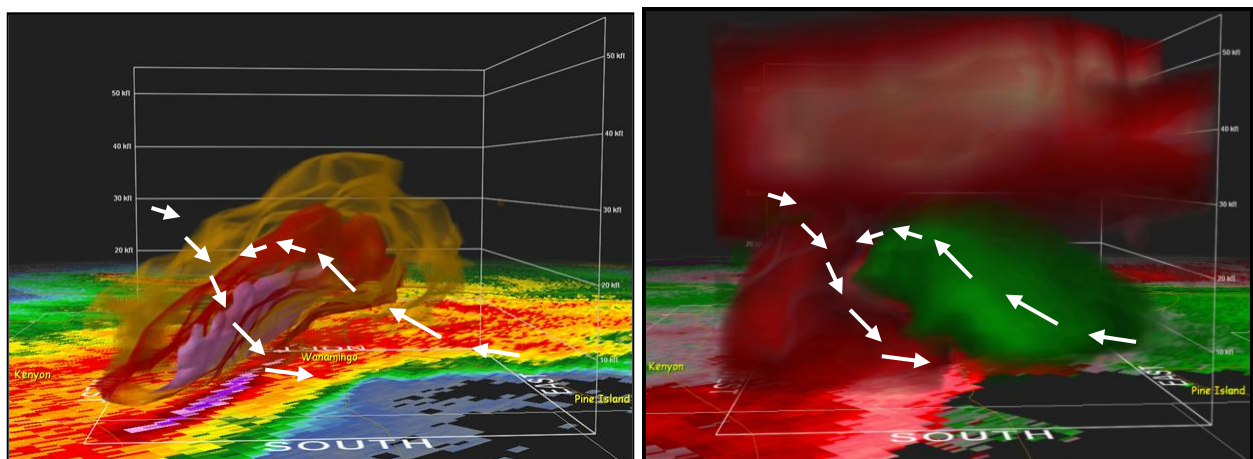


Figure 5: This side-by-side comparison shows the reflectivity (left) and velocity (right).